Technology Opportunity

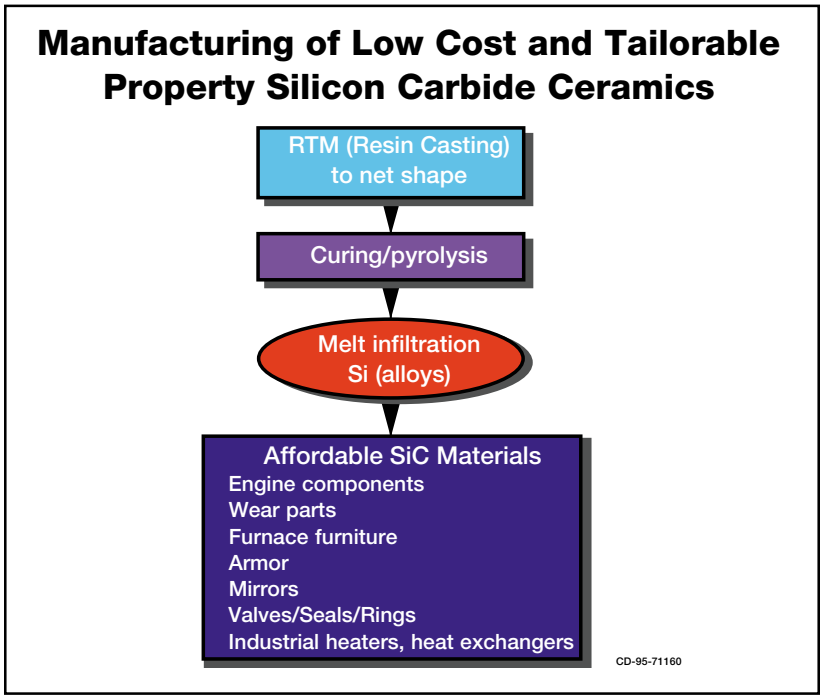
Low Cost Silicon Carbide-Based Ceramics With Tailorable Microstructure and Properties

The National Aeronautics and Space Administration (NASA) seeks to transfer the fabrication technology for low cost silicon carbide-based ceramics. The fabrication approach, developed at Glenn Research Center in collaboration with Dynacs Engineering Company, Inc., is being used to produce silicon carbide-based ceramics and Interpenetrating Phase Composites (IPC) with tailored microstructure and properties. The precursor materials used in this process are low cost. This processing approach has near-net and complex shape capabilities. NASA seeks companies that are interested in developing and commercializing these materials for a variety of low- and high-temperature applications.

The Technology

This process consists of the production of a microporous carbon preform and its subsequent infiltration with liquid silicon or refractory metal-silicon alloys. The microporous preforms are made by the pyrolysis of a polymerized resin mixture at modest temperatures. Pore volume and pore size are carefully tailored to control the size and distribution of the final constituents. Low cost tooling is used to produce near-net and complex shapes. Silicon (alloy) infiltration is carried out below 1450 °C.

This process has been used to fabricate interpenetrating phase composites with silicon carbide based matrices. It is also suitable for various kinds of reinforcements, such as whiskers and particulates.



The process can also be used to fabricate composites with three-dimensional microstructures. A number of key properties of these materials, such as strength and toughness, creep, and environmental and thermal shock resistance, can be tailored.

Benefits

- Tailorable microstructure, composition, and properties.
- Manufacturable since
  - All the constituents are off-the-shelf, low-cost chemicals.
  - Process requires no special chemical handling and uses inexpensive tooling for molds.
  - Processing carried out below 1450 °C for relatively short durations.
- Approach has near-net and complex shape capabilities.
- Adaptable process and can be modified to accept virtually any type of particulate reinforcement.

Potential Commercial Uses

- Aerospace industries: Seals, rings, space mirrors, and shields.
- Energy industries: Radiant heater tubes, heat exchangers, heat recuperators, and components for land-based turbines for power generation.
- Nuclear industries: First wall and blanket components of fusion reactors and other components.
- Microelectronic industries: Components for diffusion furniture (boats, tubes).
- Armor, wear-resistant parts, and foundry crucibles.
- Valves, seals, and rings.

Options for Commercialization

The fabrication parameters have been optimized, and properties of the resulting materials have been tested at NASA Glenn. Additional development might be needed to optimize and further refine the properties for specific applications. NASA is seeking partners to take this technology to the next step.

If your company is interested in the low cost silicon carbide-based ceramics or if you desire additional information please contact us.

Contact

Commercial Technology Office
Attn: TOPS
NASA John H. Glenn Research Center
at Lewis Field
Mail Stop 7–3
Cleveland, OH 44135–3191
Phone: (216) 433–3484
Fax: (216) 433–5012
E-mail: cto@grc.nasa.gov
http://cto.grc.nasa.gov

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References

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